Design Guide: How to Make Homes Cool and Efficient

The Problem

Though tools and methods are available for the design of energy-efficient HVAC systems, they are not often used when it comes to production homes. That's partly because builders of production homes are unaware that these tools exist. In addition, the existing design methodologies are often hard to find, as they are buried inside various code documents that also include large amounts of unrelated information.

The Solution

The *California Residential New Construction HVAC Design Guide*, produced by the consulting firm ConSol, addresses these problems by consolidating the relevant information for the HVAC design process into an easy-to-use reference and training tool. It presents a start-to-finish breakdown of the HVAC design process and discusses how each step can help lead to an energy-efficient system. It also highlights how some elements of HVAC system design fit into the overall construction process, and it discusses specific measures that can be used to reduce HVAC energy use in production homes. In addition, it identifies which personnel need to be involved with the different components of the HVAC design to ensure that it is energy efficient.

Features/Benefits

The design guide breaks down the HVAC design process into seven high-level steps to guide the development of an energy-efficient system (**Figure 1**).

The guide also includes specific recommendations for special design topics, such as the following:

- Create a list of all building orientations for a production-home development (to the nearest 45 degrees) using a site/plot map of the development. Then calculate loads for only these orientations and assess the potential to downsize equipment and duct sizes for certain plots from the worst-case orientation, which requires the largest capacity equipment and ducts.
- Calculate room-by-room loads, in addition to those for the whole house, for each house plan. This will allow you to accurately determine how to distribute airflow.
- Use in-line manual dampers in ducts to allow for different balancing needs due to different building orientations.
- Place supply registers on a high wall facing a window or exterior wall. This location produces the best air mixing without "short-circuiting" the supply air into the return airstream and without directly heating or cooling the window (see **Figure 2**, next page).
- In two-story houses, install air returns on both floors to reduce system cycling.
- Place furnaces in the attic instead of the garage. This typically allows for shorter ducts, which results in less conductive heat loss/gain and less resistance to airflow.

The guide also provides a table that lists HVAC, building design, and construction personnel and describes how they are affected by HVAC system design components. This makes it easy to identify the key personnel who need to be involved with design decisions. In addition, the guide provides a checklist of HVAC-related items to be discussed with stakeholders early in the design process. Example items for discussion include where to locate the condenser, refrigerant lines, ducts, and the thermostat.

Applications

The *California Residential New Construction HVAC Design Guide* is written for HVAC designers, architects, and builders

Figure 1: HVAC design process

The *California Residential New Construction HVAC Design Guide* describes a seven-step design process.

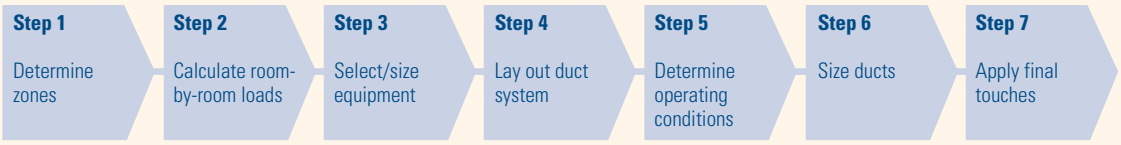
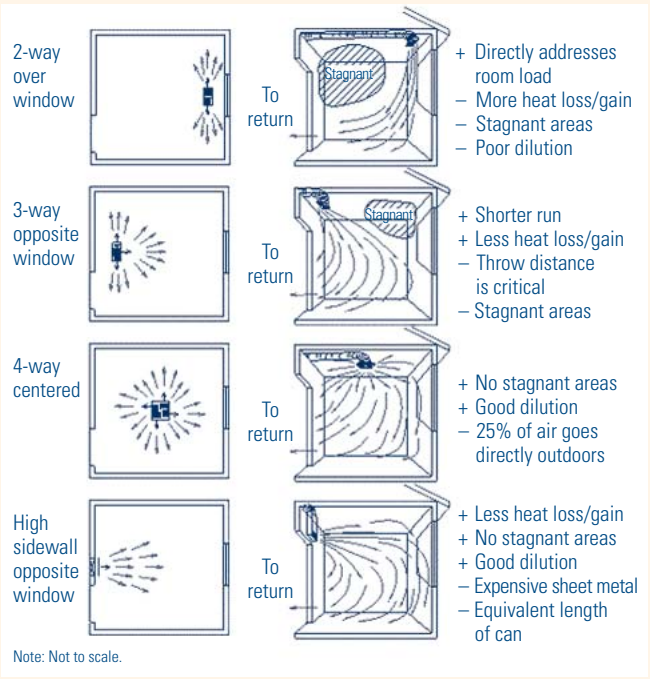


Figure 2: Ceiling register locations

High sidewall orientation provides good air mixing with minimal heat loss or gain.



Note: Not to scale.

and is particularly suited for production homes in California and areas with similar climates. The HVAC systems discussed in the guide are split or single-packaged air conditioners or heat pumps with a cooling capacity of 5 tons or less that are used in residential applications.

California Codes and Standards

The guide highlights California building codes that are relevant to air-conditioning design. For instance, the 2001 California Mechanical Code requires that all residential duct systems be sized according to the Air Conditioning Contractors of America (ACCA) *Manual D*, which requires ACCA *Manual J*. An update is scheduled for this code at the end of 2006, which may alter the *Manual D* requirement so that it applies only to homes needing outdoor air. Also, the 2001 *Residential Manual* of Title 24 dictates how heat loss and gain calculations are to be performed and establishes the temperatures to be used for sizing equipment. The 2005 *Residential Manual*, effective October 1, 2005, changes the design temperatures to be used and also offers an alternate sizing method. ConSol will update the guide as these codes or other changes dictate.

What's Next

ConSol will use the design guide to train builders, planners, and others involved with production homes. Although the California Mechanical Code requires the use of ACCA *Manual D*, many jurisdictions are unaware of this requirement, and it is often not enforced. By educating production-home builders and others, this guide should help to ensure compliance with the code.

Collaborators

The Building Industry Institute, ConSol, and Fluent Inc. collaborated on this project.

For More Information

Detailed reports on this project can be downloaded from the web at www.energy.ca.gov/pier/final_project_reports/CEC-500-2005-118.html.

To view Technical Briefs on other topics, visit www.esource.com/public/products/cec_form.asp.

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About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) program. PIER supports public-interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

Arnold Schwarzenegger, *Governor*

For more information see www.energy.ca.gov/pier

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